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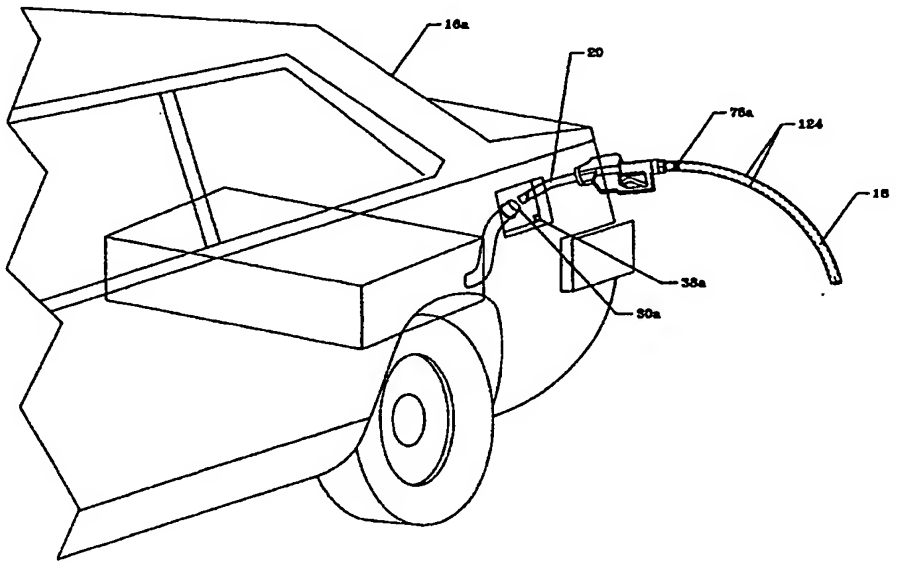

(57) Abstract

A sensor system for dispensing materials includes a transponder (38) and an antenna (78) for receiving a signal associated with a container and a dispensing means (12). A conductor (124) for transmitting a signal between the transponder (38) and the dispensing means (12) is located in a material conveying means (18). In the identification system, an RF interrogation signal is detected by a transponder associated with the container, when the material conveying means (18) is positioned adjacent to the container. The RF interrogation signal energizes the transponder (38) to transmit a return signal containing codes accessed from a memory storage means in the transponder (38) through the conductor (124).

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CONDUCTOR FOR HOSE

Technical Field

The present invention relates to a sensor system and conductors therefor.

Background Art

To reduce the harmful environmental effects of gasoline vapors escaping into the atmosphere, environmental standards have been implemented. These standards have included the Clean Air Act of 1990 which mandated the use of vacuum-assisted (VA) vapor recovery systems at retail gasoline facilities. In VA systems, means are incorporated on the nozzle of gasoline hoses for recovering vapor from the vehicle fuel tank back to the underground fuel storage tank. In U.S. Patent 5,605,182, a vehicle identification system is described. According to the patent, as vehicles begin to be produced with on-board canisters, it will be necessary to have a system for determining at the refueling point, whether a vehicle has been equipped with an onboard canister. If the vehicle does have an onboard canister or ORVR, the dispenser VA system could be shut-off during the refueling operation to prevent fresh air from being ingested into the system. Likewise, if the vehicle is not equipped with an ORVR, the dispenser VA system could be made operative to capture vapors during fueling.

RF identification systems have been provided in the past which have enabled a base station to interrogate any of a number of vehicles in a fleet in order to obtain vehicle and operator information. According to prior systems, in order to generate an RF signal to interrogate a vehicle, a high power signal would need to be transmitted to the nozzle through the fuel hose.

Due to the highly flammable nature of the fuel and vapor passing through the hose, this high power signal would create an unreasonable risk of fire, and hence, render the system too dangerous for use. The system described in U.S. Patent 5,605,182 uses circuitry to limit the power in the wire, and additional circuitry at the driver circuit on the nozzle to accumulate energy and boost the driver signal so that it can power the transponder on the vehicle. Also, slip rings and brush blocks are required where the hose attaches to the nozzle to allow 360-degree rotation of the nozzle. Also, the four or five conductors needed for the system require a complicated connector at the hose to nozzle connection, and such a connection may be a highly hazardous failure spot in the presence of gasoline.

Also, continuous use and flexing of the hose may cause the conductors in the hose to fatigue and break. There is a need for a simpler signaling system, and a need for conductors that are fatigue resistant, to transmit the signal in the hose.

Disclosure of Invention

A hose of the invention has an electrical signal conducting means in or on an inside wall thereof. The electrical signal conducting means has elongation properties at least equivalent to the elongation properties of the most extensible material used to make the hose and a resistivity of 0 to 100 ohm*cm. In one illustrated embodiment, the hose is reinforced with wire braiding and the wire braiding is used as a conductor.

The conductor may be encased in conductive rubber having a resistivity of 0.1 to 100 ohm*cm.

In various embodiments, the conductor may comprise monofilament or multifilament wire coiled spirally around the inside of the hose, monofilament or multifilament wire disposed in a sinusoidal or square wave form on the inside of the hose, monofilament or multifilament spring wire coiled into a spring and disposed inside of the hose, a conductive rubber composite containing wire fibers, metal powder or metal shavings, or even a conductive organic material such as polyaniline.

In some embodiments, it may be advantageous for connections between the conductor and the circuitry of a sensor a system associated therewith to be encased in conductive rubber having a resistivity of 0.1 to 100 ohm*cm.

The invention further comprises a signaling system for dispensing material through a hose comprising, (a) a chip associated with a container adapted to receive material, (b) a signal inducing/receiving coil connected to a dispensing means adapted for close association with the chip associated with the container, (c) a signal transmitting coil connected to said inducing/receiving coil on a distal end of said dispensing means, (d) a signal receiving coil on conveying means, said signal receiving coil being in close proximity to said signal transmitting coil, (e) conductor means for transmitting a signal from the signal receiving coil to means for controlling the dispensing of the material.

In the illustrated embodiment, the container is a fuel tank on a vehicle, the material is fuel, the dispensing means is a nozzle on a hose, the conveying means is a hose, and the controlling means is a fuel pump, and a transponder is associated with a container adapted to receive material, a signal receiving antenna is embedded in conveying means, the signal receiving antenna is in close proximity to the transponder when material is being dispensed, conductor means is used for transmitting a signal from the signal receiving antenna to means for controlling the dispensing of the material, and the controlling means is a fuel pump.

Brief Description of Drawings

Fig. 1 is a perspective view showing a prior art vehicle refueling station;

Fig. 2 is a perspective view of a fuel nozzle showing the prior art antenna means applied thereto;

Fig. 3 is a perspective view showing an embodiment of the prior art transponder;

Fig. 4 is a perspective view of the transponder of Fig. 3 encased in an annular housing for attachment to a vehicle; and

Fig. 5 is an end view of the nozzle of Fig. 2 taken along line 5-5.

Fig. 6 illustrates a hose of the invention with a spiral conductor;

Fig. 7 illustrates a hose of the invention with a wave form conductor;

Fig. 8 illustrates a hose of the invention with a spring wire conductor;

Fig. 9 illustrates a hose of the invention with a composite conductor; and

Fig. 10 illustrates a hose of the invention wherein the wire braid reinforcement of the hose is used as a conductor.

Fig. 11 illustrates a low power signaling system of the invention.

Fig. 12 illustrates an alternative low power signaling system of the invention.

Detailed Description of the Invention

Referring now to the drawings, Fig. 1 is a simplified illustration of a fuel station of the prior art, generally designated as 10, depicting a single dispenser 12 at an island 14, and a vehicle 16 positioned at the dispenser. The dispenser 12 includes a fuel hose 18 with a nozzle 20 connected at a distal end thereof by an adapter 22. As shown in more detail in Fig. 2, nozzle 20 includes a hand grip portion 24 having a lever 26 that is manually operable in a conventional manner to dispense fuel. At the distal end of the hand grip 24 is a nozzle spout 28. Nozzle spout 28 can be of conventional form, having a generally cylindrical shape that is sized to fit into a standard vehicle fill pipe, such as the fill pipe 30 illustrated in Fig. 1. Hand grip 24 also includes an interior passage, not shown, which is in communication with a passage in the nozzle spout 28 for conveying fuel from the hose 18, to the vehicle fill pipe 30.

Although the present invention is illustrated with reference to gasoline refueling for vehicles, those skilled in the art will recognize that the sensing system of the invention will be applicable to dispensing other fuels to other containers, and is applicable as well to other materials, such as grains.

In the prior art illustration, nozzle spout 28 preferably includes openings 32 which are used in conjunction with a vacuum-assisted vapor recovery system, installed in the dispenser 12, to transmit vapors released during fueling back to an underground fuel storage tank (not shown), in

order to prevent the vapors from being released into the environment. When a vapor recovery system is installed, the passage through the nozzle spout 28 will preferably be coaxial, to permit fuel to be dispensed into the vehicle through one passage while vapors are simultaneously being conveyed back to the underground storage tank.

As shown in Figs. 1 and 2, an annular housing 34 is disposed coaxially on the spout 28, adjacent the grip 24. The housing 34 is preferably ring-shaped to enable the housing to be disposed circumferentially about the spout 28 and retained against the grip 24. The housing 34 is preferably comprised of a protective material such as plastic. A driver circuit and antenna are mounted inside of the housing, and the housing is filled in with an epoxy material to form an intrinsically safe barrier between the circuit and the outside atmosphere. The external leads for the driver circuit are also surrounded by an epoxy seal to prevent air gaps in the housing.

As shown in Figs. 1 and 5, a second annular housing 36 is attached to vehicle 16, adjacent the vehicle fill pipe 30. This housing 36 is also ring-shaped to enable the housing to be disposed circumferentially about the vehicle fill pipe 30 adjacent the distal end thereof, so as to be in close proximity to the nozzle 20, and particularly the nozzle spout 28, when the nozzle is placed into the fill pipe for vehicle refueling. Sealed in the interior of the housing 36 is a transponder 38 and antenna 78.

Once a sensor is activated, it generates an enable pulse in a standard manner for transmission to a driver circuit on the nozzle 20. A Sensor is connected to the driver circuit on the nozzle spout 28 via a cable which extends through the interior of the fuel hose 18. It is preferable to extend conductor (wire/cable) 54 through the interior of the hose 18, rather than along the exterior, in order to prevent tampering or damage to the cable.

If a vehicle with an attached transponder 38 is located within the broadcast range of the antenna 70, the interrogation signal will charge the transponder via the transponder antenna 78 to generate an identification signal. The transponder 38 and antenna 78 are shown in Fig. 4. Antenna 78 is preferably a wound wire coil having a diameter sized to fit on the vehicle fill pipe 30 and a number of windings to provide a broadcast frequency of 38kHz. In addition, the antenna 78 preferably has a planar configuration as shown in Fig. 4, to enable the antenna to detect the field from the nozzle antenna 70 any time the transponder 38 is within the field range of the antenna 70, regardless of the vehicle orientation at the dispenser. The circumferential disposition of the antenna 78 about the spout 28 and of the antenna 78 about the fill pipe 30 advantageously insures that these antennas will read the generated electromagnetic fields irrespective of the relative angular positioning of housings 34 and 36.

In order to complete the connection between the controller 40 and the driver circuit at the

fuel hose and nozzle junction, a brush block 46, as shown in Fig. 3, is included in the nozzle adapter 22. Brush block 46 contacts an electrical connection in the fuel hose 18 when the nozzle adapter 22 is assembled onto the hose 18 to complete the circuit. Brush block 46 enables the low power signals to be transmitted through the hose 18 throughout a 360-degree rotation of these components.

Since the wire is placed inside the hose when the hose is manufactured, in prior art hoses, if the wire breaks or separates from its connectors, a fire hazard develops. In the present invention, the wire is designed to be fatigue resistant such that the life of the wire exceeds the life of the rubber used to make the hose. In another embodiment, the conductor is embedded in the wall of the hose. When the conductor is a wire, the wire may be encased in conductive rubber so that if separation occurs, electrical continuity may be maintained. Also, signals are transmitted at low power levels. The connections are made inductively, simplifying the connection and minimizing the chances of separation. The system operates at such low power levels; it is believed that the probability of a spark developing from the signaling system is less than that created by static electricity in prior art hoses.

With reference to Figs. 6, 7, and 8, when wire is used in a hose, the wire has a length longer than the length of the hose, in order to prevent tension from being placed on the wire when the hose is extended. The wire may be disposed inside the hose in or on the wall of the hose in a spiral 64 (Fig. 6), bent into a zigzag (wave form) pattern 74 (Fig. 7), or coiled into a spring 84 (Fig. 8).

Optionally, the rubber matrix around the wire may comprise a conductive rubber 55 having a resistivity of 0.1 to 100 ohm·cm.

Soldering may be used to connect the wire to circuitry used in the sensor system, or the ends of the wire may be placed in electrical conductive rubber in close proximity to the connectors in the circuitry. The conductive rubber provides an electrical contact between the wire and the circuitry without using solder joints.

Conductive rubber which may be used in the invention has a tensile modulus of 300 to 400 psi at 50% elongation, an elongation of 270 to 350%, a max tensile of 1800-2100 psi, brass coated steel wire/rubber adhesion of approximately 50 Newton's force (75% rubber coverage) and T_{90} cure time of 30 minutes.

When a wire is used, the conductor may be bent into a sinusoidal wave conformation, a helical conformation, a triangular wave shape, or any similar length compressive shape.

With reference to Figs. 6-10, conductor portion 64,74,84,94,104 may comprise any material which provides conductivity sufficient to maintain an electrical circuit under the

conditions in which it is employed.

An electrical wire conductor is preferred, because most conductive rubbers are inoperable over the distance that must be traversed by the conductor. In an embodiment where the conductor comprises a wire in a conductive rubber matrix, if the wire is broken, the resistivity of the conductive rubber is minimized because of the short distance between the two ends of a broken wire, since resistance is dependent on the length of the path and the area of the rubber according to the formula:

$$R = pl/A \quad \text{where}$$

R is resistance in ohms

p is resistivity of the material in ohm-cm

l is distance traversed in cm

A is the area of the material surrounding the break.

And, of course, since the wire of the conductor is embedded in conductive rubber, the area (A) will be very large.

Fig. 6 illustrates an embodiment 60 wherein a hose 62 contains a conductor 64, in the form of monofilament or multifilament wire, which is coiled spirally inside the hose, in or on the inner hose wall, wherein the spiral of the conductor corresponds substantially with the circumference of the hose. The wire in the conductor may optionally be coated with a conductive rubber material 66.

In an alternative embodiment 70, as illustrated in Fig. 7, at least one wire 74 is provided in the rubber matrix of hose 72 wherein wire 74 has a wavy configuration, which provides elongation, and the flexibility needed. If the wires are imbedded in a conductive rubber matrix, an electrical circuit can be maintained even if the wires are broken.

In Fig. 8, 80 illustrates a hose 82 where a wire 84 is helically wound, optionally around a highly elongatable conductive rubber matrix 55a. Because of the flexibility, and durability of the wire 84, it is not mandatory that the rubber core be conductive, but in the illustrated embodiment it is provided as a safety measure in case a separation occurs in wire 84. In case of such a separation, the conductive rubber core would provide an alternative path for the electrical circuit created by the interrogator.

The wire used for the conductor may be filament wire, or cord or stranded wire. In an illustrated embodiment, the wire comprises 6 strands of high tensile steel (hts) wire woven around a wire core.

The wire used in an illustrated conductor has a diameter of 0.04 to 0.25mm, preferably 0.08 to 0.18mm. In the illustrated embodiment, the wire has a diameter of 0.15mm.

Those skilled in the art will recognize that other means may be provided to enhance the conductivity of a rubber matrix that is employed in a hose for the purpose of providing an electrical circuit, such as metal filings, powdered metal, metal shavings, etc.

With reference now to Fig. 9, 90 represents an embodiment wherein the conductor portion 94 comprises wire fibers 96 that are embedded in a conductive rubber matrix 95 in hose 92. In the case where wire fibers are used, it is required that the rubber matrix be conductive since it provides the path for the electrical current, and is augmented by the wire fiber.

Fig. 10 illustrates an embodiment 100 where the wire braid reinforcement 104 of hose 102 is used to conduct the electrical signal of the sensor system.

In an alternative embodiment, the conductivity may be provided by an organic conductor, such as polyanaline, which is available from AlliedSignal Corporation through Americhem. Such material has Product Code No. 36721-C1.

In general, it is believed that composites which are conductive enough to provide an electrical circuit in the environment of the hose of the invention can be used in the invention if they have a conformational relationship that permits 100-300% elongation. By conformational relationship it is meant that the material may be provided in a helical structure, bent into a signwave or squarewave, bent into a saw tooth wave or other configuration, such that it may expand in length without creating stress on the molecular makeup of the material.

When a conductive rubber matrix 55 is employed to encase the conductor, it is preferred that a rubber matrix having a resistivity of 0.1-100 ohm·cm be used. In the illustrated embodiment, rubber matrix 55 has an electrical resistivity in the range of 5-50 ohm·cm, and in the specific embodiment has a resistivity of 7 ohm·cm.

When rubber is stretched, its resistivity increases, and the 7 ohm·cm resistivity for the illustrated embodiment is obtained in the non-stretched rubber. When stretched 17%, the resistivity in the conductive rubber in the illustrated embodiment is about 10 ohm·cm.

The conductive rubber matrix may be fundamentally syndiotactic polybutadiene rubber, natural rubber, styrene butadiene rubber (SBR), halobutyl rubber, or any similar type rubber composition, and mixtures thereof. The rubber may be made conductive by employing large amounts of an electrically conductive carbon black in the formulation thereof. Although normal loadings of carbon black in a rubber composition used in a tire are about 25-45 phr, in the conductive rubber compositions used herein, the carbon black is used at a loading of about 75-105 phr, and in the illustrated embodiment 95 phr electro conductive carbon black is used.

Electrically conductive carbon black of the type used in the illustrated embodiment is

available from Cabot Corporation and is designated ASTM N472.

The rubber must have physical properties that are compatible with its placement in the hose structure. The conductive rubber within the invention may have a tensile modulus (at 50% elongation) of 300 to 400 psi, an elongation at break of 270 to 350%, max tensile of 1800-2100 psi, brass coated steel wire/rubber adhesion of approximately 40 to 60 Newton's force (75% rubber coverage), and T_{90} cure time of 10 to 30 minutes.

An example of a non-productive portion of a conductive rubber composition may comprise rubber (NR), 80-100 parts by weight per hundred parts by weight rubber (phr) conductive carbon black, 10-24 phr silica, 0-8 phr tackifiers, 0 to 4 phr antioxidants, 0-6 phr antiozonants, and 0-2 phr stearic acid. The cure package for the rubber composition may comprise 0-2 phr antioxidant, 5-15 phr ZnO, 0-2 phr accelerators, 0-2 phr MgO, and 1-5 phr sulfur.

With reference now to Fig. 11, a fuel dispensing nozzle of the invention comprises a prior art fuel dispensing nozzle fitted with a signal inducing and receiving (inducing/receiving) coil 112, connected by hard wire 114 to signal inducing coil 116. Signal inducing coil 116 is coupled by proximity to signal receiving coil 118 on hose 18.

Those skilled in the art will recognize that coils 112,116 and 118 may have the same construction, but are identified by their function, due to their position in the signaling system.

When coil 112 activates a chip by induction on a vehicle which is being refueled, the signal induced in the chip is received by coil 112 and carried by hard wire 114 to coil 116. The magnetic flux around coil 116 caused by the signal induces an electrical current (signal) in coil 118. This method of inducing a signal from coil to coil is known to those skilled in the art as double coupling.

Since signals in the millivolt range are sufficient to initiate the signal in the system, and the signal is transmitted through the hose in the millivolt range, no step up and step down circuitry is needed, and only two conductors are needed in hose 18 to carry the signal to the fuel pumps, whereas four or five conductors are needed in the prior art systems.

In the case where wires are used as the conductors, and the wires are insulated and embedded in the wall of the hose, the conductor will be double insulated from the material being dispensed through the hose.

As illustrated in Fig. 12, in an alternative embodiment of the invention, a battery powered transponder 38a may be attached to the vehicle 16a, and when nozzle 20 approaches fill pipe 30a, the transponder may activate a signal in a coil 112 (Fig. 11), or an antenna 78a (Fig. 12) in hose 18 can be used for receiving the signal from the transponder on the vehicle,

and the signal received by the antenna can be sent directly to the fuel pumps using conductors 124, said conductors being any type of conductors described herein.. Receiving antennas which can be used are turns of tightly coiled wire, spring wire as described above, and any antenna of the type described in commonly assigned (to The Goodyear Tire & Rubber Company) copending applications DN1996-082, DN1997-192, DN1997-193 and DN1997-194 and art cited therein. Also, conductive rubbers described therein can be used as the conductive rubber used in the hose as described above.

Battery powered transponders which may be used in the invention may be obtained from I.D. Technologies Inc. or Micron Communications Inc.

Again, millivolt signals will be sufficient, and the system will be intrinsically safe.

While the invention has been specifically illustrated and described, those skilled in the art will recognize that the invention may be variously modified and practiced without departing from the spirit of the invention. The invention is limited only by the following claims.

CLAIMS

1. A hose having electrical signal conducting means in or on an inside wall thereof, said electrical signal means having elongation properties at least equivalent to the elongation properties of the most extensible material used to make said hose, and a resistivity of 0 to 100 ohm*cm.

2. The hose of claim 1 in which said hose is reinforced with wire braiding and said wire braiding is used as a conductor.

3. The hose of claim 1 in which said conductor is encased in conductive rubber having a resistivity of 0.1 to 100 ohm*cm.

4. The hose of claim 1 in wherein said conductor comprises monofilament or multi filament wire coiled spirally around the inside of said hose.

5. The hose of claim 1 in wherein said conductor comprises monofilament or multi filament wire disposed in a sinusoidal or square wave form on the inside of said hose.

6. The hose of claim 1 in wherein said conductor comprises monofilament or multi filament spring wire coiled into a spring and disposed inside of said hose.

7. The hose of claim 1 in wherein said conductor comprises a conductive rubber composite containing wire fibers, metal powder or metal shavings.

8. The hose of claim 1 in which said conductor comprises polyaniline.

9. The hose of claim 1 in wherein connections between said conductor and circuitry of a sensor system associated therewith are encased in conductive rubber having a resistivity of 0.1 to 100 ohm*cm.

10. A signaling system for dispensing material through a hose comprising

(a) a chip associated with a container adapted to receive material,

(b) a signal inducing/receiving coil connected to a dispensing means adapted for close association with said chip associated with said container,

(c) a signal transmitting coil connected to said inducing/receiving coil on a distal end of said dispensing means,

(d) a signal receiving coil on conveying means, said signal receiving coil being in close proximity to said signal transmitting coil,

(e) conductor means for transmitting a signal from said signal receiving coil to means for controlling the dispensing of said material.

11. The signaling system of claim 10 wherein said container is a gas tank on a vehicle, said material is fuel, said dispensing means is a nozzle on a hose, said conveying means is a hose, and said controlling means is a fuel pump.

12. A signaling system for dispensing material through a hose comprising

(a) a transponder associated with a container adapted to receive material,

(b) a signal receiving antenna embedded in conveying means, said signal receiving antenna being in close proximity to said transponder when material is being dispensed,

(e) conductor means for transmitting a signal from said signal receiving antenna to means for controlling the dispensing of said material.

13. The signaling system of claim 13 wherein said container is a gas tank on a vehicle, said material is fuel, said conveying means is a hose, and said controlling means is a fuel pump.

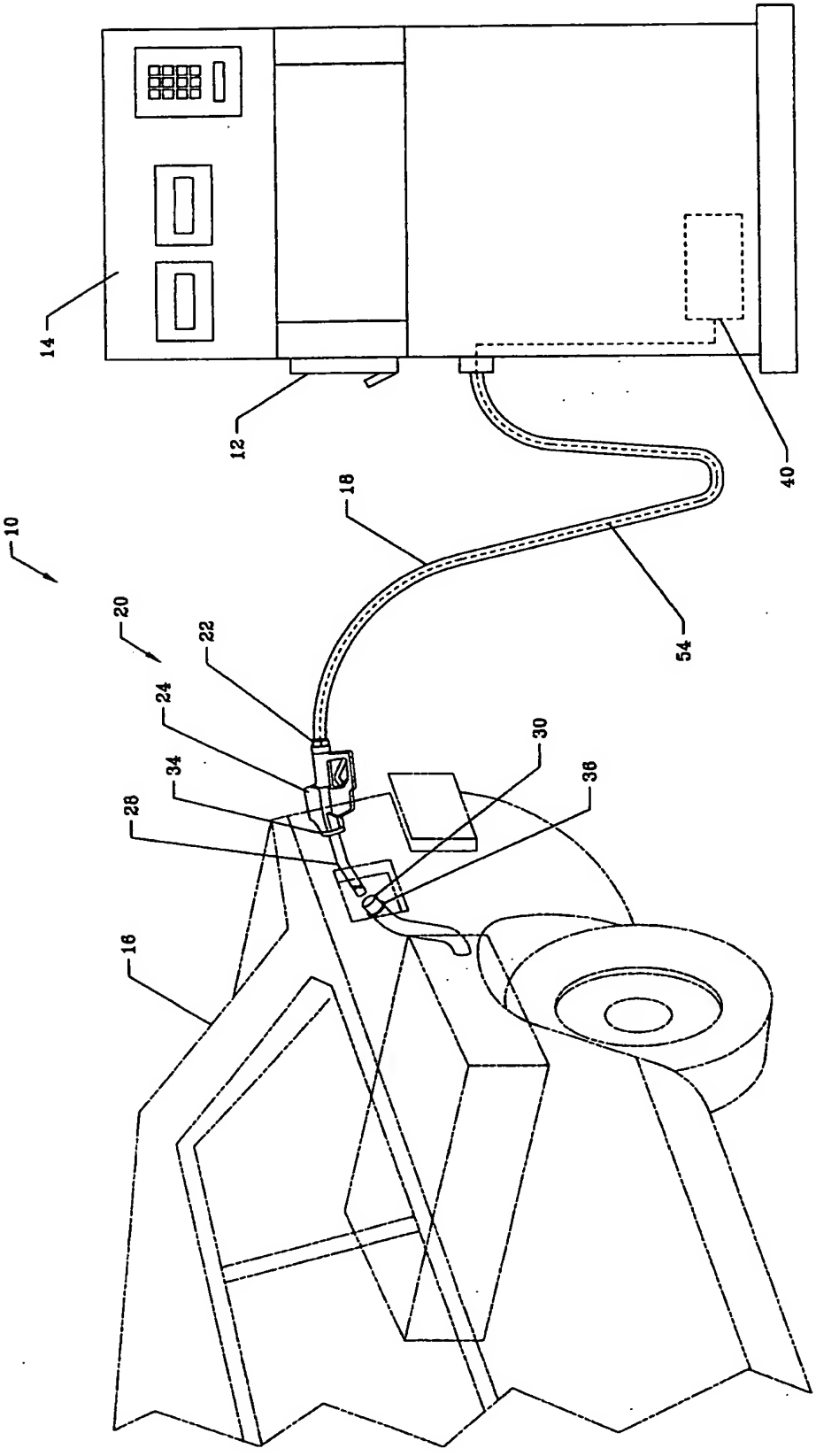


FIG-1
PRIOR ART

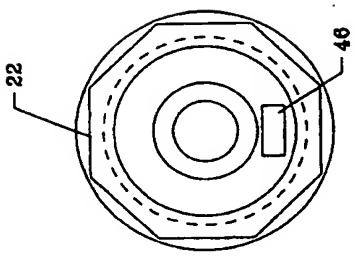


FIG-3
PRIOR ART

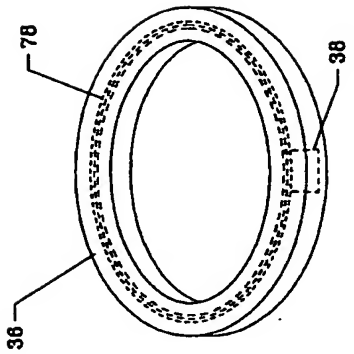


FIG-5
PRIOR ART

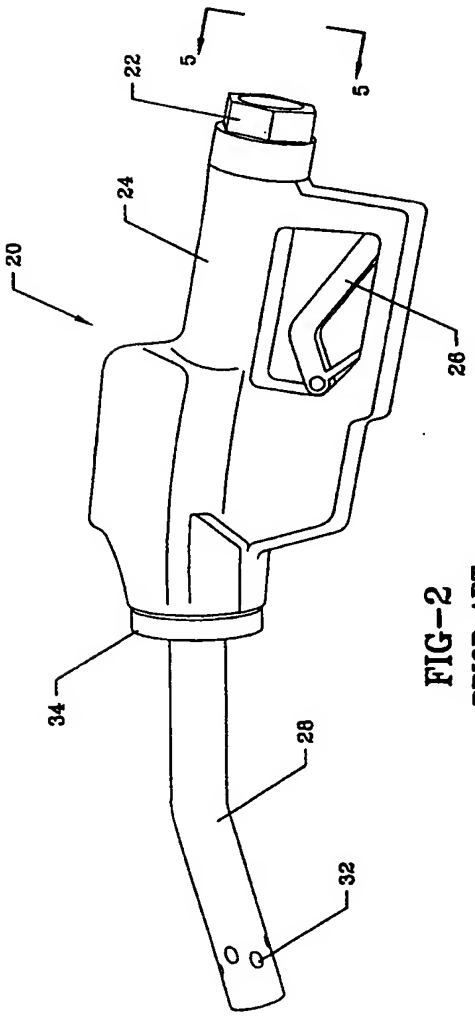


FIG-2
PRIOR ART

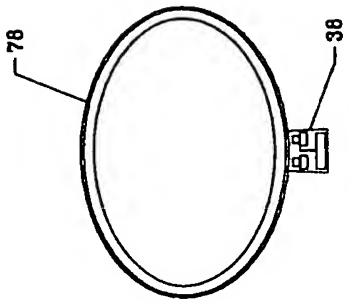
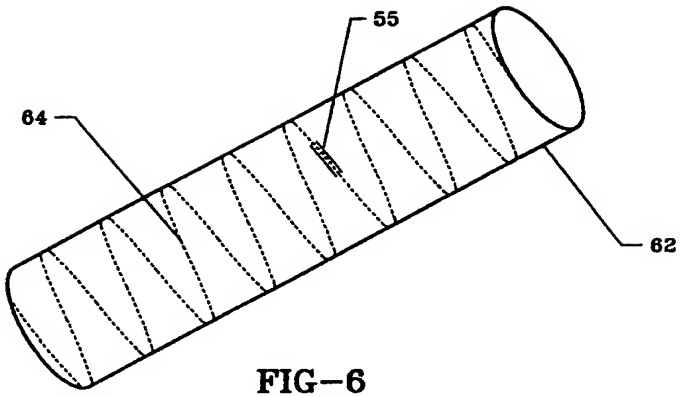
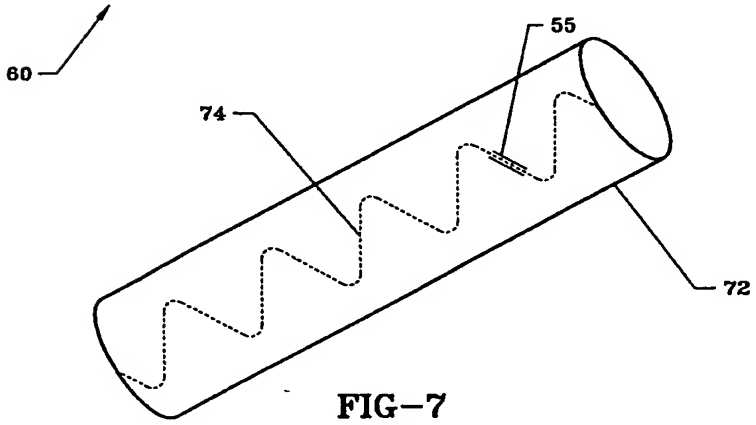


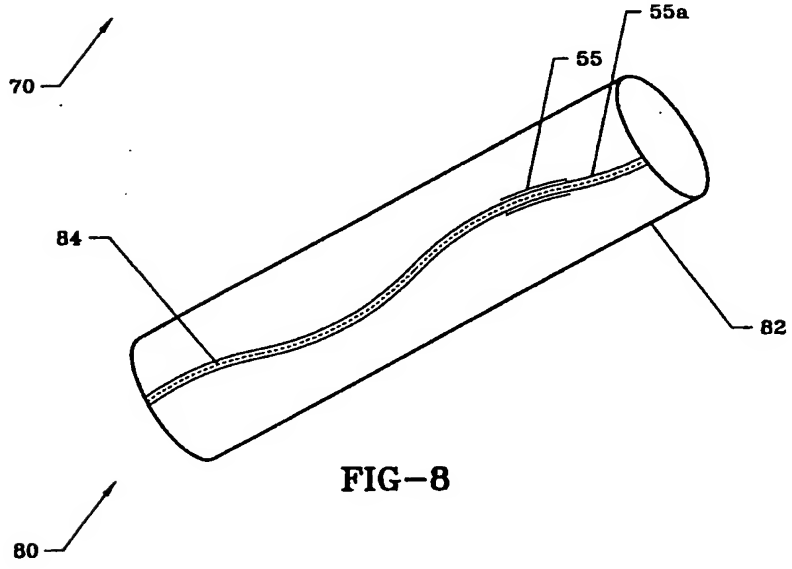
FIG-4
PRIOR ART



FIG–6



FIG–7



FIG–8

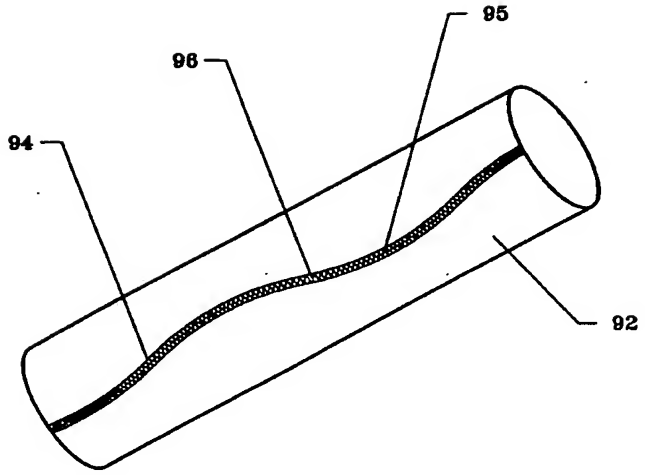


FIG-9

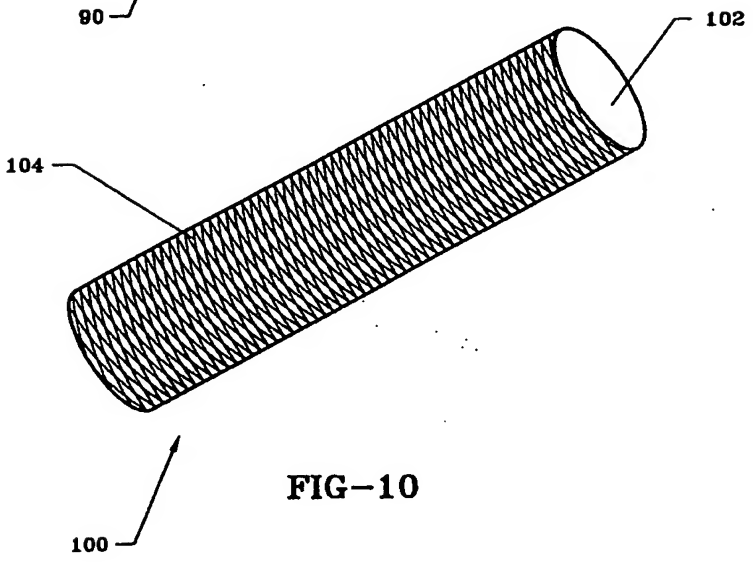


FIG-10

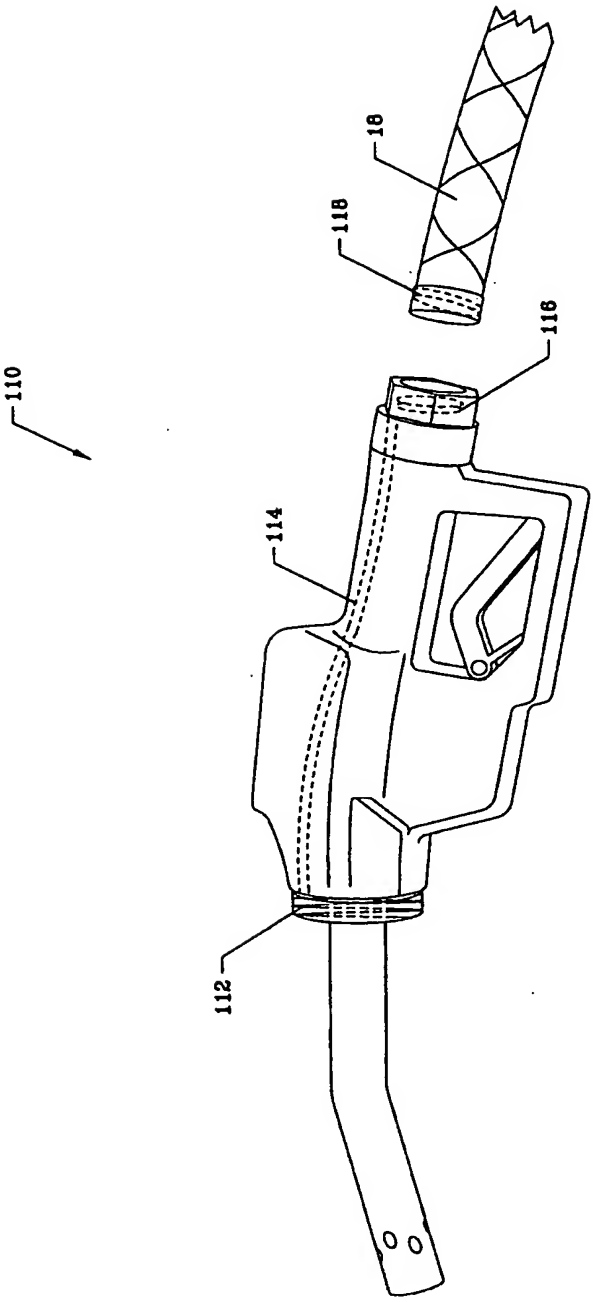


FIG-11

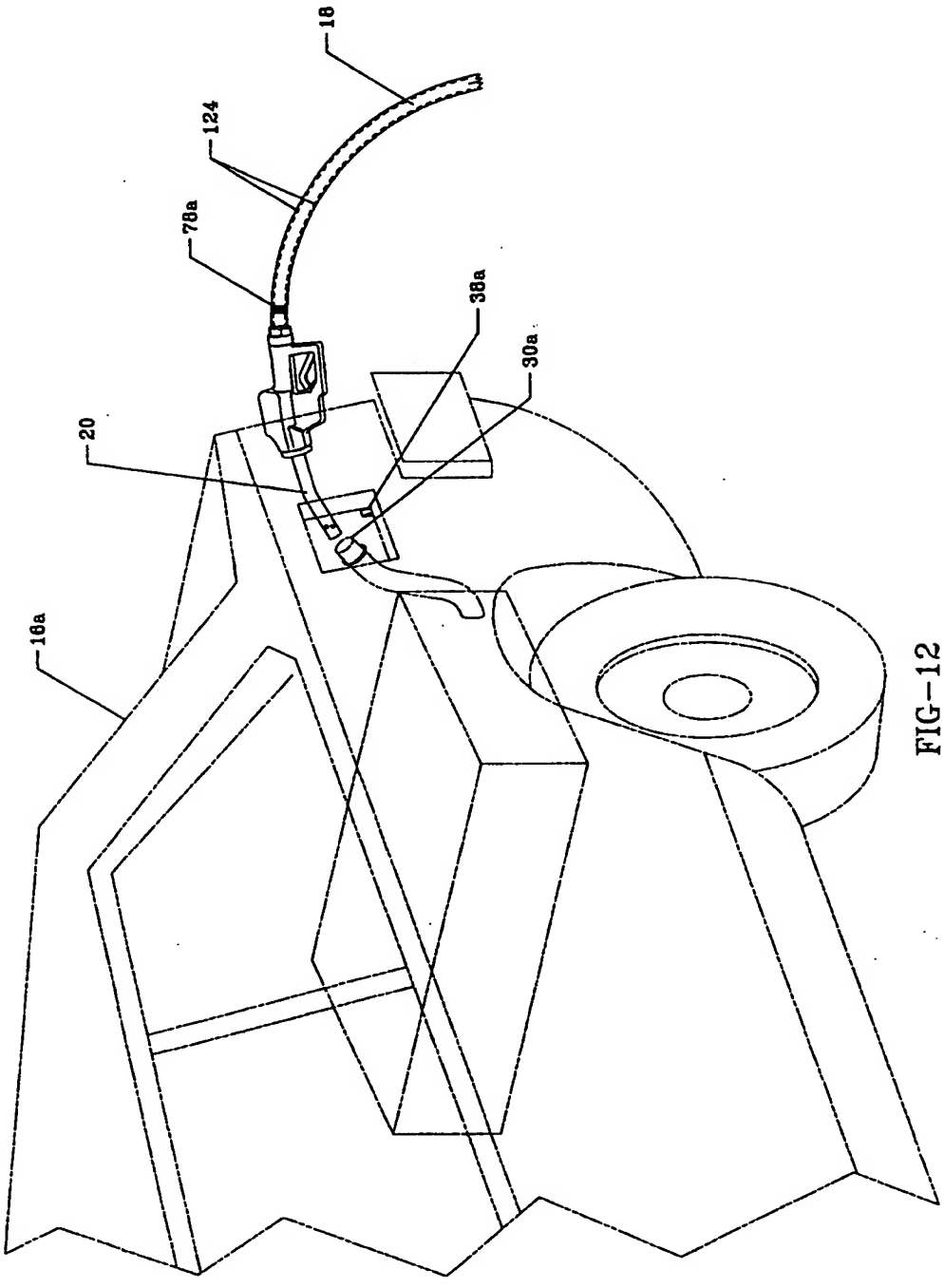


FIG-12

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/04316

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16L11/127 F16L11/118 B67D5/33

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F16L B67D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 675 780 A (BARNES JOHN A ET AL) 23 June 1987 see column 1, line 5 - line 12; figure 1 see column 1, line 48 - line 56 see column 3, line 41 - line 68 ---	1,4
A	US 3 828 112 A (JOHANSEN H ET AL) 6 August 1974 see column 2, line 1 - line 12 see column 2, line 61 - column 3, line 19 ---	2,3,7,9
A	EP 0 758 671 A (EASTMAN KODAK CO) 19 February 1997 see abstract -----	8

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 November 1998	11 01. 1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Brosio, A

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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 98/04316

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

CLAIMS 1-9
CLAIMS 10-13

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-9

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

In ational Application No
PCT/US 98/04316

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4675780 A	23-06-1987	NONE	
US 3828112 A	06-08-1974	BE 807619 A	15-03-1974
		CA 995600 A	24-08-1976
		JP 49120221 A	16-11-1974
EP 0758671 A	19-02-1997	US 5716550 A	10-02-1998
		JP 9137088 A	27-05-1997